BioOne COMPLETE

All the Energy That's Fit to Print: Communicating the Value of Energy

Author: Herendeen, Robert

Source: BioScience, 62(7) : 691-692

Published By: American Institute of Biological Sciences

URL: https://doi.org/10.1525/bio.2012.62.7.12

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://complete.bioone.org/journals/BioScience on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

All the Energy That's Fit to Print: Communicating the Value of Energy

Energy and the Wealth of Nations: Understanding the Biophysical Economy. Charles A. S. Hall and Kent A. Klitgaard. Springer, 2011. 407 pp., illus. $99.00 (ISBN 9781441993977 cloth).

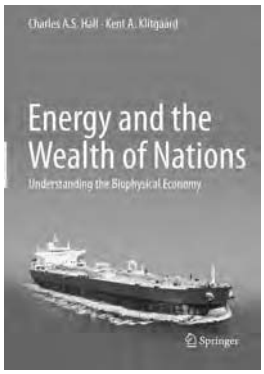
Analysts should understand energy's fundamental role in supporting human endeavor, its increasing scarcity, and its environmental impact. Consumers (all of us—including energy analysts) should encounter energy prices that tell the truth. Charles A. S. Hall is a leading and indefatigable exponent of this understanding, and when he teams up with economist Kent A. Klitgaard, one would expect some detail on how energy realities translate into responsive economic policies. But the book *Energy and the Wealth of Nations: Understanding the Biophysical Economy* does not deliver on this. At times, it is exasperatingly diffuse and repetitive, but it does offer a broad range of compelling arguments—and diverse data—to emphasize energy's deep significance to the world's economic health.

In summary, the book's message is that today's neoclassical economics (NCE) fails to convey, firmly and quickly enough, that we are running out of easily accessed energy, fossil or renewable, especially oil. NCE hides and ignores this truth through myriad subsidies and mantras of substitution, yet despite institutional and societal denial, the consequences are emerging—and our eventual accommodation will be wrenching. Using production theory that explicitly recognizes energy's essential role and the proper metric of net—rather than gross—energy tells the straight story.

As a long-time energy analyst, I agree with these declarations, but I wish that they had been made more systematically and concisely and that a translation to practical, adaptive economic policies had been laid out more clearly. In *Energy and the Wealth of Nations,* there are sharply written and brilliantly focused criticisms of NCE; sections on net energy and its most popular metric, EROI (energy return on energy invested, which is generally declining over time); various graphical demonstrations to connect energy-price variations to economic expansion or contraction; and a discussion of peak oil (a well-deserved topic to spotlight). In particular, the implication of declining EROI is vividly shown (hypothetically) in chapter 15, in which an increasing fraction of extracted energy must be directed back to the energy industries. However, any creative economic measures (e.g., subsidies reform, energy or carbon taxes or caps with rebates to low-income households) that could guide a smooth transition are scarcely mentioned. Key words such as *cap and trade*, *taxes*, *equity*, *policy*, *transition*, *time scale*, and *distribution* are absent from the index, although several of these terms appear very briefly in the text.

Throughout the book, I found myself implicitly faulting Klitgaard, perhaps unfairly, for the lack of a strong economist's voice. (The voice seems primarily Hall's.) My point of view as a veteran analyst is that appropriate, aggressive pricing of energy is necessary, and I had wanted the authors to illustrate how to do that strongly, fairly, and gradually enough to minimize the pain. But in the preface, they say that the book is "an economics text like no other" (p. viii). There is much here on economic history as seen through an energy lens; perhaps, for some readers, that is enough. Puzzlingly, the authors make no recommendation as to the intended reader's level of proficiency in economics or energy analysis, and the assumed level of understanding varies widely from chapter to chapter.

Almost everything from the golden age of energy analysis (from around 1970 to the present) is here but in scattershot form and with no solid roadmap. Within the 14 pages of chapter 12 ("The required quantitative skills"), the book discusses linear, nonlinear, and exponential functions; statistics; correlation; econometrics; calculus; and analytic versus numerical modeling and is interspersed with repeated denouncements (largely justified, but once per chapter is enough) of economics' infatuation with mathematics at the expense of real data. The well-known formula $I = PAT$ is given much later in chapter 19 ("Environmental considerations") but is also not listed in the index. There are no numerical problems in the book, but extensive tables and graphs are included.



Energy and the Wealth of Nations is an engaging, stimulating, and laudably agitating read, but it is too disjointed to serve as a textbook. I am both fascinated by the breadth of its references and frustrated by the writing's unevenness, casual editing, and personal indulgences. (How can the authors repeatedly call *gross domestic product* "wealth" throughout the text when they have explained the difference between wealth [stock] and income [flow] in chapter 1?) The book is basically a collection of transcripts of illustrated lectures, written in an informal classroom style. (I can see the authors leaning

doi:10.1525/bio.2012.62.7.12

Downloaded From: https://complete.bioone.org/journals/BioScience on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

on the lectern and holding forth, with anecdotes.) What was needed to make this a textbook, or at least a more accessible and usable reference, was an editor's attention to enforce consistency, focus, and coherence.

The final chapter ("Living the good life in a lower EROI future") is a quick overview of the potential issues and the distinct possibility of a lower-energy but more fulfilling life, to which I personally subscribe. It is a soft landing after the hard delivery in much of the book but leaves us short on details. The final thought that I carry, however, is from chapter 15, which shows the EROI diagrams mentioned above. In making the diagrams, the authors assumed that the world energy system had an EROI of 20 in 2005, which, they say, will sink to 5 by 2050. (An EROI of 1 means a zero net energy yield.) They admit to an arbitrary value, but by putting it out, they reinforce the question of what minimum EROI is needed to run a modern society—not the society we have now, but the one we want. We do not know now what that minimum value is, but we will have to know by, say, 2050.

If you are ready to embrace this bedrock problem, reading *Energy and the Wealth of Nations* is a place to start. You will either hate it or (maybe) love it, but you will not sleep through it.

ROBERT HERENDEEN

Robert Herendeen (rherende@uvm.edu) is a fellow with the Gund Institute for Ecological Economics at the University of Vermont in Burlington. Trained as a physicist, Herendeen has worked in energy analysis since 1971.

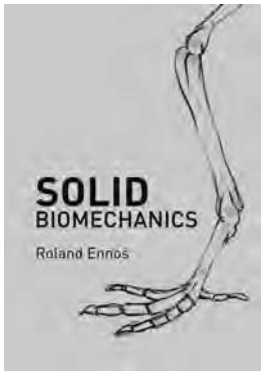
THE MECHANICAL PROPERTIES OF BIOLOGICAL MATERIALS

Solid Biomechanics. Roland Ennos. Princeton University Press, 2011. 264 pp., illus. $65.00 (ISBN 9780691135502 cloth).

My interest in biomechanics really took off with the 1975 publication of R. McNeill Alexander's *Animal Biomechanics*, a volume that, for the first time, provided readers with an accessible coverage of mechanical principles as applied to animal biology: materials, structures, fluid dynamics, and energetics. The focus of the field then was essentially on the application of these principles to animals. In the recent book *Solid Biomechanics* by Roland Ennos, the scope is both narrower, insofar as the author largely ignores dynamic systems, and far broader. His work encompasses both plant and animal materials—the structures they create, the problems they encounter, and the interactions among the components of a structure, among the structures themselves, and, finally, between structures and their environments. These are topics in which Ennos is well versed; for many years, he has conducted pioneering research on the mechanics of such diverse subjects as the designs permitting controlled bending of insect wings and the ways in which plants either resist or facilitate deformation and how they anchor themselves to the ground.

Too often, biologists enter the field of biomechanics with an inadequate foundation in the most basic properties of materials; I certainly did when I fumbled my way into the field over 50 years ago and then gradually acquired related knowledge in a haphazard fashion. Now it is easier: Ennos gives us a first-rate introduction to how material properties can be examined; how they are affected by the way in which forces are applied to them; how they deform then recover from stress; how they break; and how, in certain configurations, their fracture can be avoided. All this is basic to the author's subsequent treatment of biological materials.

In *Solid Biomechanics*, Ennos very sensibly does not distract us with discussions of conventional solids such as crystals or metals; these, after all, are rarely found in biological systems. Instead, he considers the properties of what we have inside us—and what may be found in insects or trees: the real materials of living organisms. One of the most remarkable biological materials to exist is *resilin*, the rubbery protein found in arthropods that acts as a restoring force in insects' wings or as a versatile energy store. The book's treatment of this protein is as clear as any I have read, revealing just why rubbers show long-range soft elasticity, thus differing from more familiar, stiffer though nonetheless springy materials. Of course, nature has access to the gamut of organic polymers, from the ever-versatile cellulose with its varied everyday uses to the (biologically) more expensive structural proteins and carbohydrate–protein or protein–mineral composites, in which the mechanical properties can be fine-tuned by adjusting the relative proportions or the degree of cross-linking between the components. One example of this is the exoskeleton of insects, in which different regions form tough rigid plates and tubes or flexible joints or strong fibers.



At their simplest, material structures can be fibers, plates, tubes, or sacs. In general, fibers may be pulled, twisted, or pushed; they resist the first action but not the other two. More complex structures may be subjected to a greater range of stresses, and their reactive behavior, in turn, becomes more complex. Some biological structures, such as worms or blood vessels, can be modeled as internally pressurized tubes; bones or grass stems may be more usefully modeled as beams having load-bearing behaviors, such as bending, breaking, or buckling. These

doi:10.1525/bio.2012.62.7.13

Downloaded From: https://complete.bioone.org/journals/BioScience on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use